

AMENDMENTS TO THE CLAIMS

Claims 1-19 (Canceled)

Claim 20 (Currently Amended): An apparatus for the formation of a metal film, the apparatus comprising:

precursor feeding means for bringing a chlorine-containing raw material gas into contact with a hot metallic filament to produce a precursor within a chamber housing a substrate, the precursor comprising the metallic component contained in the metallic filament and the chlorine contained in the raw material gas;

~~reducing gas heating means~~ a filament for heating a hydrogen-containing reducing gas to a high temperature and thereby producing an atomic reducing gas ~~;~~ and ;

a reducing gas nozzle for injecting the atomic reducing gas into the chamber between the substrate and the precursor feeding means, the reducing gas heating filament being disposed within the reducing gas nozzle; and

chamber heating means for heating an inner wall of the chamber to a predetermined temperature;

whereby the precursor is passed through the atomic reducing gas within the chamber to remove chlorine from the precursor by reduction, without allowing the precursor to deposit on the heated inner wall of the chamber, and the resulting metallic ion is directed onto the substrate to form a metal film on the substrate.

Claims 21-38 (Canceled)

Claim 39 (Previously Presented): The apparatus according to Claim 20, wherein the metallic filament comprises at least one selected from the group consisting of Cu, Ag, Au, Pt, Ti and W.

Claim 40 (Previously Presented): The apparatus according to Claim 20, wherein the reducing gas heating means comprises a tungsten filament.

Claim 41 (Previously Presented): The apparatus according to Claim 20, wherein the precursor feeding means comprises a flow controller to control a flow rate of the chlorine-containing raw material gas.

Claim 42 (Currently Amended): The apparatus according to Claim 20, ~~wherein the reducing gas heating means comprises~~ further comprising a flow controller to control a flow rate of the hydrogen-containing reducing gas.

Claim 43 (Previously Presented): The apparatus according to Claim 20, further comprising a direct-current power supply to supply electrical current to the metallic filament to produce the precursor.

Claim 44 (Previously Presented): The apparatus according to Claim 20, further comprising a direct-current power supply to supply electrical current to the reducing gas heating means.

Claim 45 (Currently Amended): The apparatus according to Claim 20, wherein the predetermined temperature of the inner wall of the chamber is ~~higher than a temperature of the substrate~~ in the range of 200 to 600°C.

Claim 46 (New): An apparatus for the formation of a metal film, comprising:
a chamber housing a substrate;
precursor feeding means for feeding a precursor into the chamber, the precursor feeding means being connected to the chamber, a hot metallic filament being disposed within the precursor feeding means, the precursor being produced within the precursor feeding means by bringing a chlorine-containing raw material gas into contact with the hot metallic filament, the precursor comprising the metallic component contained in the metallic filament and the chlorine contained in the raw material gas;

an atomic reducing gas nozzle for injecting an atomic reducing gas into the chamber, the atomic reducing gas nozzle being connected to the chamber, the atomic reducing gas being produced within the atomic reducing gas nozzle by heating a hydrogen-containing reducing gas to a high temperature; and

chamber heating means for heating an inner wall of the chamber to a predetermined temperature;

whereby the precursor is passed through the atomic reducing gas within the chamber to remove chlorine from the precursor by reduction, without allowing the precursor to deposit on the heated inner wall of the chamber, and the resulting metallic ion is directed onto the substrate to form a metal film on the substrate.

SUPPORT FOR THE AMENDMENTS

This Amendment amends Claims 20, 42 and 45; and adds new Claim 46. Support for the amendments is founding the specification and claims as originally filed. It is believed that no new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 20 and 39-46 will be pending in this application. Claims 20 and 46 are independent.

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

The present invention provides an apparatus for the formation of a metal film. The apparatus comprises (i) precursor feeding means for producing a precursor within a chamber; (ii) a filament for heating a hydrogen-containing reducing gas to produce an atomic reducing gas; (iii) a reducing gas nozzle for injecting the atomic reducing gas between a substrate and the precursor feeding means, where the reducing gas heating filament is disposed within the reducing gas nozzle; and (iv) chamber heating means for heating an inner wall of the chamber to a predetermined temperature.

Claims 20, 39-42 and 45 are rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,091,209 ("Claverie") taken in view of EP 4573348 ("Torres") and Microelectronic Engineering 19 (1992) pages 571-574 ("Madar") and optionally further in view of JP 60-116776 ("Inoue"), U.S. Patent No. 6,440,494 ("Arena-Foster") and U.S. Patent No. 6,001,172 ("Bhandari").

Claims 43 and 44 are rejected under 35 U.S.C. § 103(a) over Claverie taken in view of Torres and Madar and optionally further in view of Inoue, Arena-Foster and Bhandari, and taken in further view of U.S. Patent No. 6, 161,499 ("Sun").

Claims 20, 39-42 and 45 are rejected under 35 U.S.C. § 103(a) over Claverie taken in view of Torres and Madar and optionally further in view of Inoue, Arena-Foster and Bhandari, and in further view of Thin Solid Films ("Lee"), U.S. Patent No. 5,154,135 ("Ishihara") and JP 64-042394 ("Oshita").

Claims 43 and 44 are rejected under 35 U.S.C. § 103(a) over Claverie taken in view of Torres and Madar and optionally further in view of Inoue, Arena-Foster and Bhandari, and in further view of Thin Solid Films ("Lee"), U.S. Patent No. 5,154,135 ("Ishihara") and JP 64-042394 ("Oshita"), and taken in further view of Sun.

Claverie discloses a low temperature chemical vapor deposition process in which a gas stream containing a copper halide is reacted with hydrogen, and activated by a heated catalytic metal filament, to deposit a copper film on a substrate. Claverie at abstract. Claverie discloses that the gas stream containing copper halide can be formed by supplying halogen gas (X_2) or a hydrogen halide gas (HX) into a heated copper tube or pipe 22. Claverie at column 2, lines 55-58; Fig. 1. Claverie discloses a filament 14 that is "arranged within" (Claverie at column 4, line 45) Claverie's reaction chamber 10 between substrate 16 and copper tube 22.

However, Claverie and the secondary references fail to suggest that a filament for heating a hydrogen-containing reducing gas into an atomic reducing gas is disposed within a nozzle for injecting the atomic reducing gas into a chamber. Thus, the cited prior art fails to suggest the independent Claim 20 limitations of "a filament for heating a hydrogen-containing reducing gas to a high temperature and thereby producing an atomic reducing gas; a reducing gas nozzle for injecting the atomic reducing gas into the chamber between the substrate and the precursor feeding means, the reducing gas heating filament being disposed within the reducing gas nozzle". Therefore, the rejections under 35 U.S.C. § 103(a) should be withdrawn.

Claims 20-39-45 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. To obviate the rejection, Claims 20, 42 and 45 are amended.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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